

5.2 UNIQUE SUPPORT STRUCTURE-02 (USS-02)

The Unique Support Structure – 02 (USS-02) is the primary structural element of the AMS-02 Payload (Figure 5.2-1). Its purpose is to structurally support the Cryomagnet Cold Mass and the AMS-02 Experiment during launch, landing, and on-orbit loading and integrates them with Shuttle and ISS.

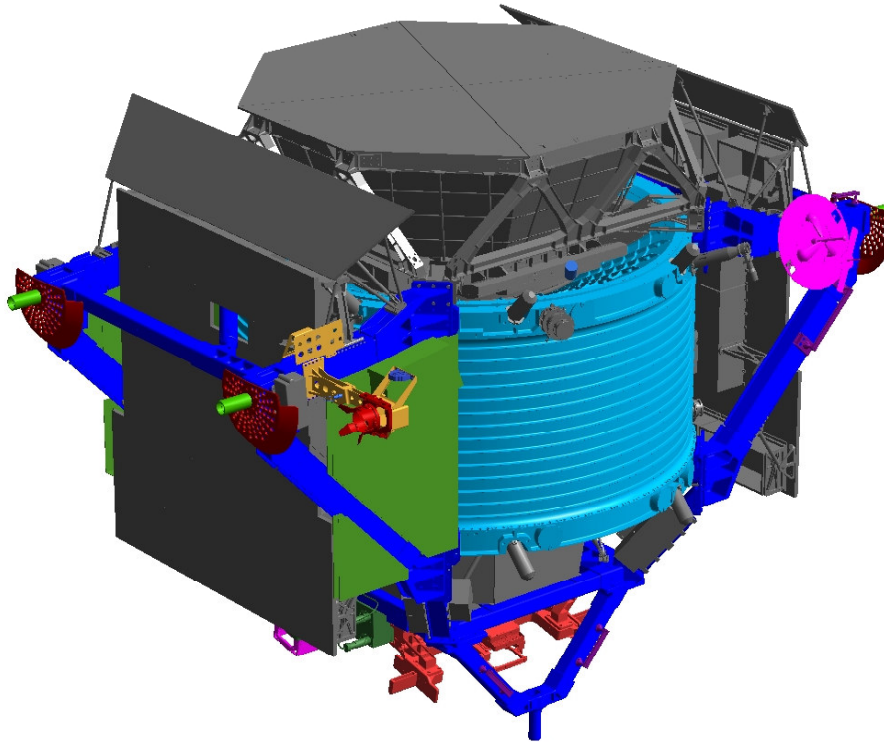


Figure 5.2-1 Alpha Magnetic Spectrometer (AMS) – 02 Payload

The USS-02 (Figures 5.2-2 and 5.2-3) consists of five subassemblies – the Upper USS-02, Vacuum Case (VC), Lower USS-02, Keel, and the AMS Payload Attach System (PAS). Each of these subassemblies is bolted and shear pinned together to form the top-level USS-02.

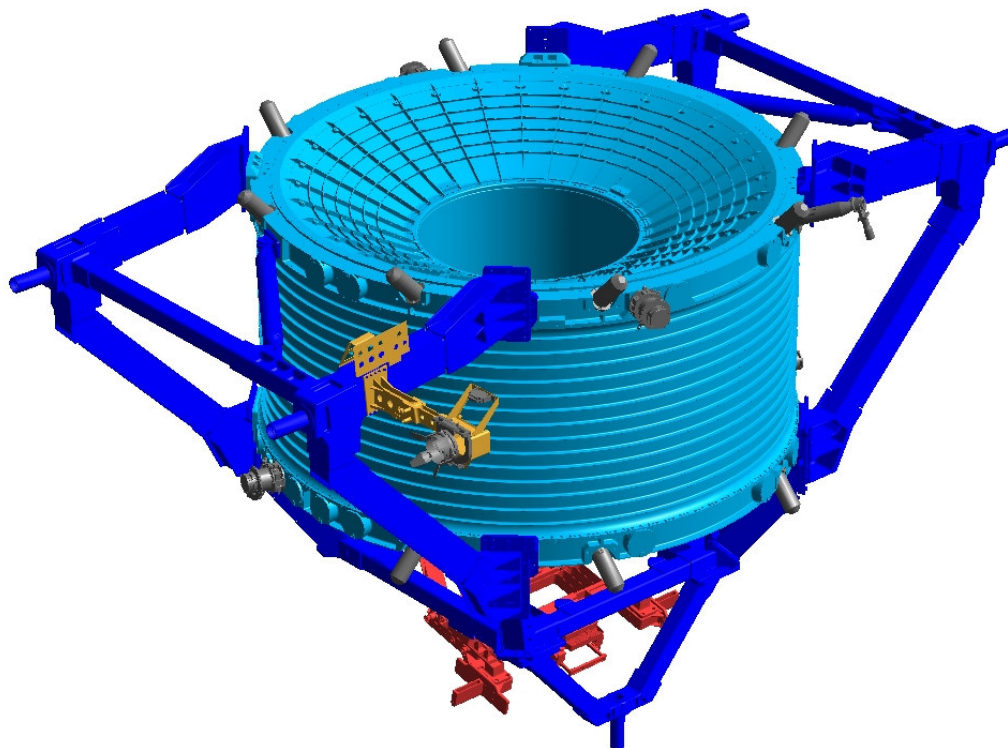


Figure 5.2-2 Unique Support Structure (USS) - 02

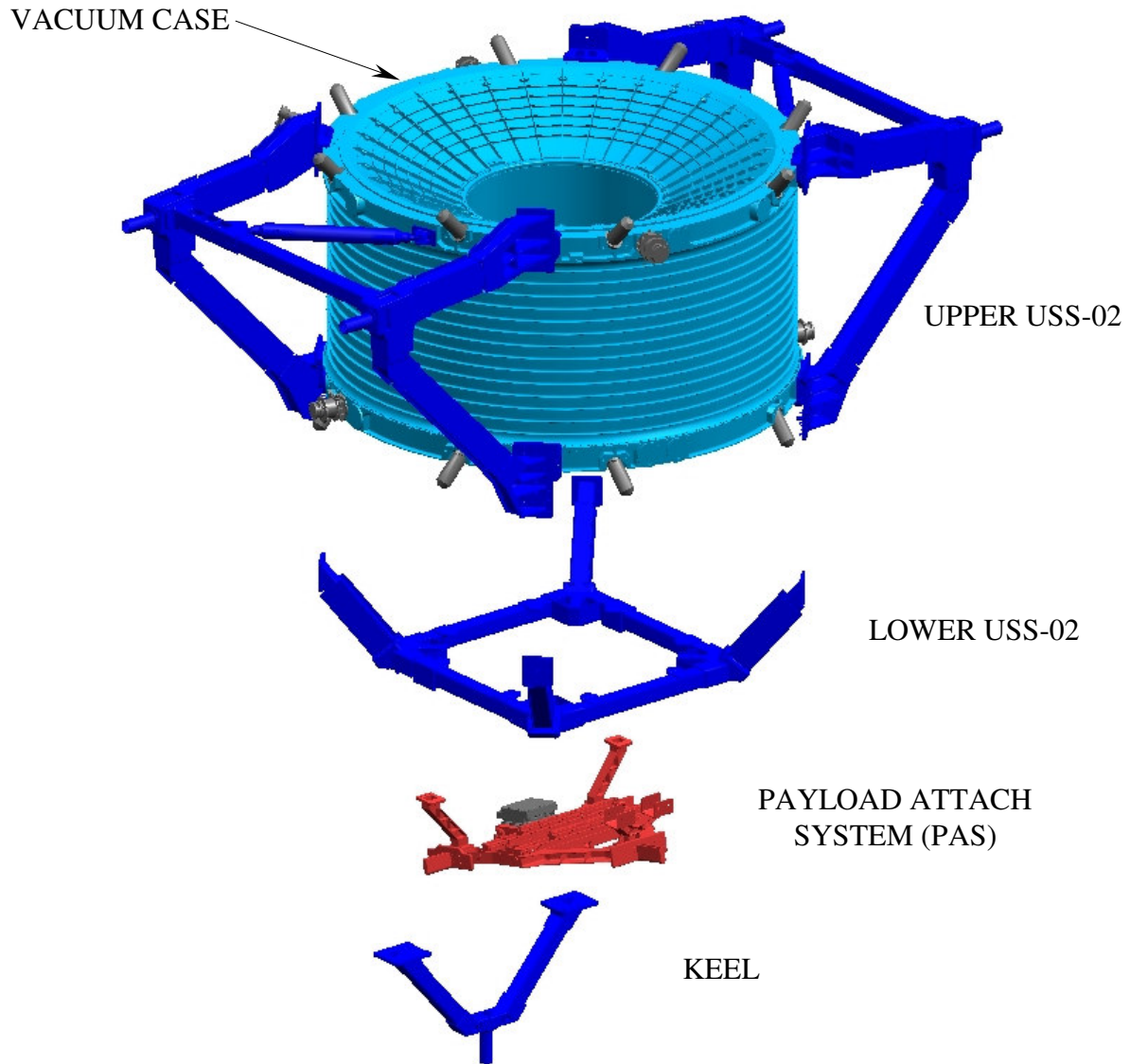


Figure 5.2-3 Subassemblies of the Unique Support Structure (USS) – 02

The Upper USS-02, Lower USS-02 and Keel are comprised of joints riveted to hollow tubes Figure 5.1-4. The joints are made of machined aluminum alloy 7050-T7451 plate and the hollow tubes are made of machined aluminum alloy 7075-T73511 extrusions.

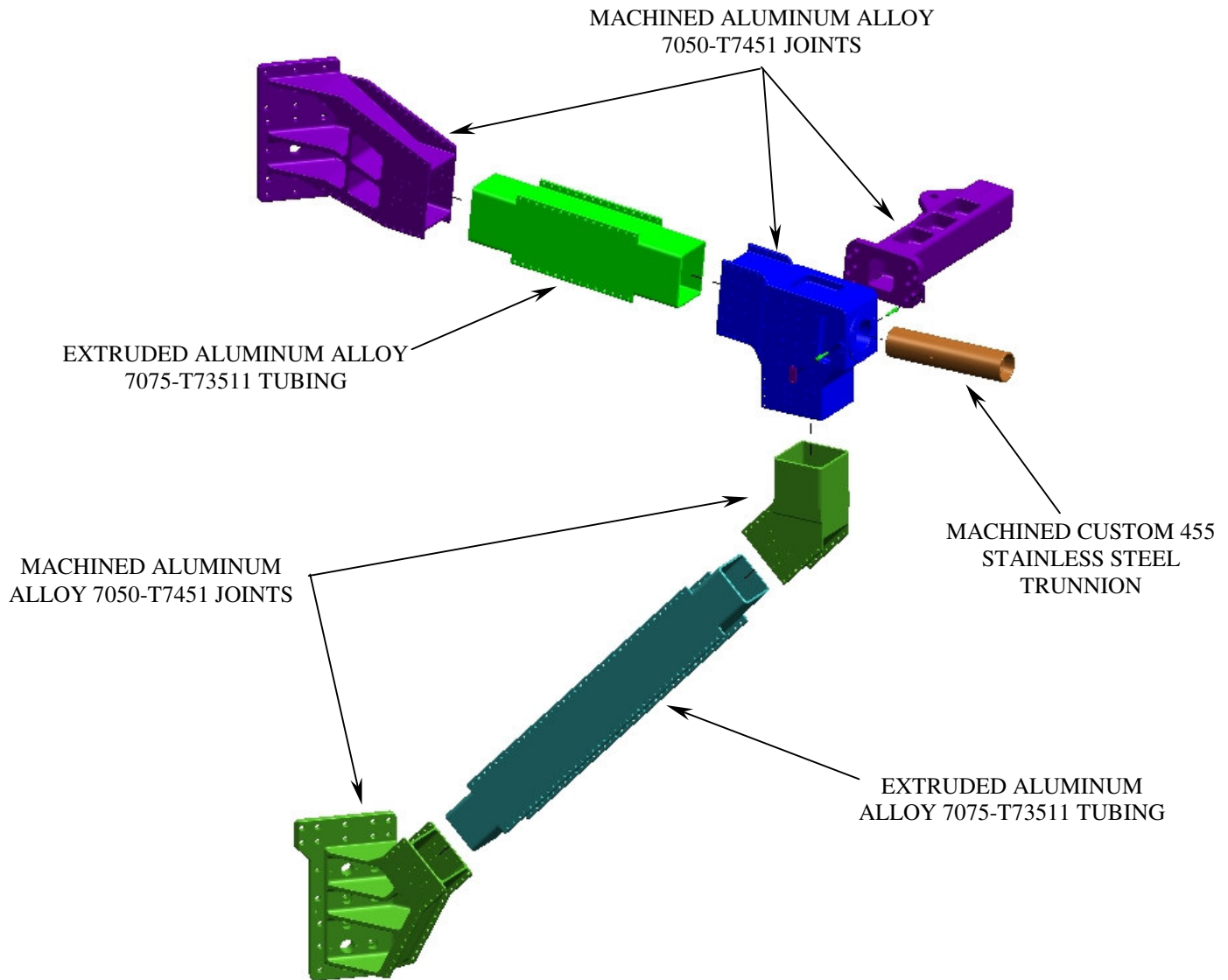


Figure 5.2-4 USS-02 Construction with Aluminum Tubes and Machined Joints

The Upper USS-02 includes two struts (Figure 5.2-5). The struts are made from machined 6061-T6511 extruded tubing, machined end fittings that are riveted to the tube, and rod-end bearings that are threaded into the end fittings. The struts are pinned to the Upper USS-02 at both ends using custom made custom 455 stainless steel shear pins.

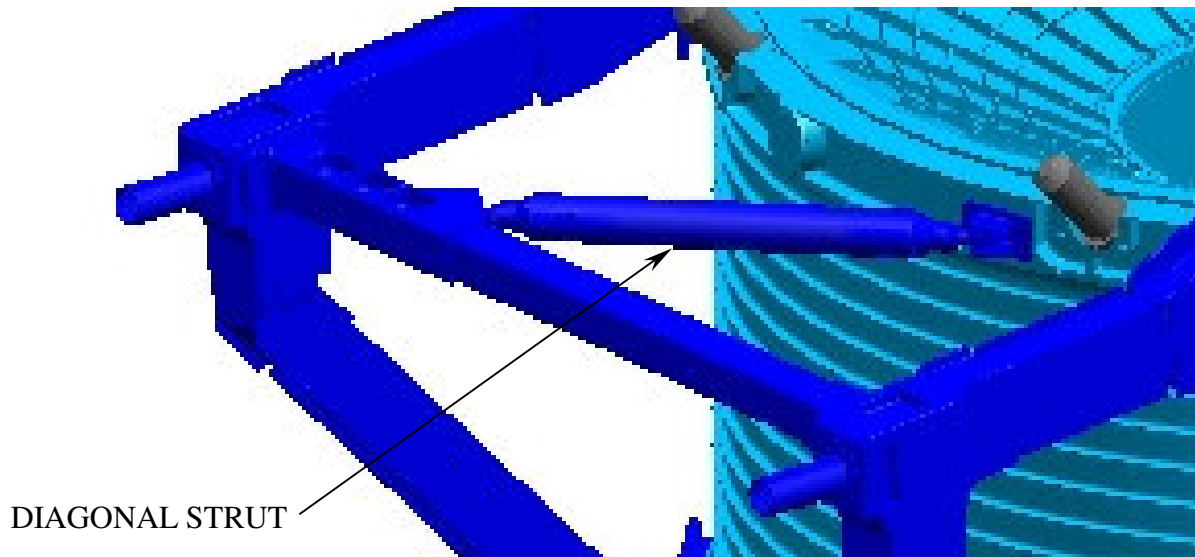


Figure 5.2-5 Location of the Diagonal Strut on the USS-02

The VC is comprised of machined parts made of aluminum alloy 7050-T7451 ring forgings and plate; aluminum alloy 2219-T7351 spin-formed plate, and A-286 stainless steel plate.

The AMS-02 PAS is comprised of components machined from 7075-T7351 plate, 7050-T7451 plate, Custom 455 stainless steel bar, and spherical bearings made from stainless steel with self-lubricating Teflon liners.

All threaded fasteners are made from A-286 stainless steel ranging in strength from 180 to 200 KSI. All structural threaded fasteners are tested and certified per the NASA/JSC Fastener Integrity Program by the NASA/JSC Receiving Inspection Test Facility (RITF) lab. All installed structural threaded fasteners have a secondary means of back-out prevention including locking inserts, locking nuts, self-locking bolts, or lock wire (in non-EVA accessible areas only).

Shear pins are made from Custom 455 stainless steel. Portions of the shear pins fit inside aluminum bronze bushings that fit inside holes in the aluminum alloy USS-02 joints. All shear pins are secured by machined aluminum alloy 6061-T651 block-off plates that are secured to the USS joints with two screws per plate.

All USS-02 parts except the aluminum bronze bushings have corrosion resistant metal finish. The aluminum bronze bushings are inherently corrosion resistant and do not require additional metal finish. Exposed aluminum surfaces are anodized. Stainless steel parts are passivated. Aluminum faying surfaces that require electrical conductivity are Alodined or nickel-plated.

Many of the Joints and all of the tubes that make up the USS-02 have .25" thru holes or 0.190 inserts for hardware mounting. These holes are referred to as the "generic holes" of the USS.

The riveted components of the USS-02 are electrically bonded together via the large number of conductive rivet connections. Resistance of each riveted joint will be verified after assembly. Non-conductive bolted interfaces will be bonded using bonding straps secured to the USS-02 generic hole pattern. Anodize around the holes used will be removed and the resulting surfaces will be Alodined prior to installation of the bonding strap. The resistance across each bonding strap will be verified to be in compliance with Space Station Electrical Bonding Requirements (SSP30245) class "S."

All of the AMS-02 Experiment components bolt to the USS-02 per JSC 29095, Alpha Magnetic Spectrometer - 02 (AMS-02) Experiment/Payload Integration Hardware (PIH) Interfaces (Part II). The USS-02 has unique interfaces for the TRD/Upper TOF, ACC, Tracker, Lower TOF, RICH, ECAL, Cryomagnet, Cryocoolers, and Cryomagnet Dump Diodes. All other AMS Experiment Hardware subcomponents bolt to generic holes on the USS-02 and VC.

The VC supports the Cryomagnet Cold Mass by 16 composite straps. The Cryocoolers are mounted to the VC Upper and Lower Support Rings. Details of the VC design are covered in Section 5.1.4 of this Safety Data Package.

The Shuttle interfaces consist of four sill trunnions and scuff plates, one keel trunnion, and one Remotely Operated Electrical Umbilical (ROEU) Payload Disconnect Assembly (PDA). The ROEU and PDA are GFE from Shuttle. Shuttle provided hardware is discussed in Section 5.4. The PDA is mounted to the EVA Retractable PDA Bracket.

This bracket is a single hinged mechanism that is held in place by one PIP Pin. One PIP pin holds the bracket in the nominal extended position and the other pin holds it in the retracted (or folded) position. Details of the EVA Retractable PDA Bracket are covered in Section 5.4.3.7.

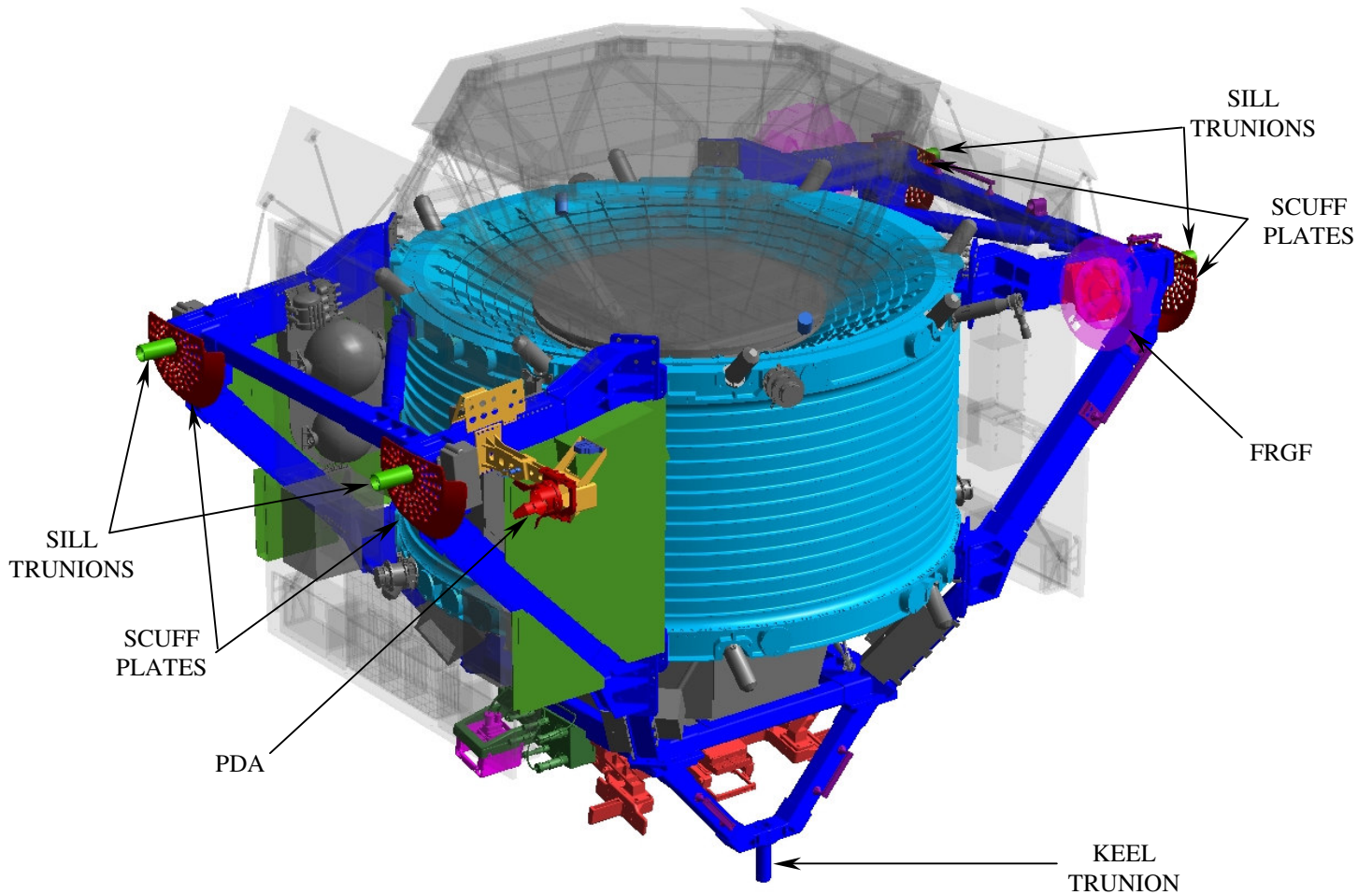


Figure 5.2-6 AMS-02 Shuttle Interfaces

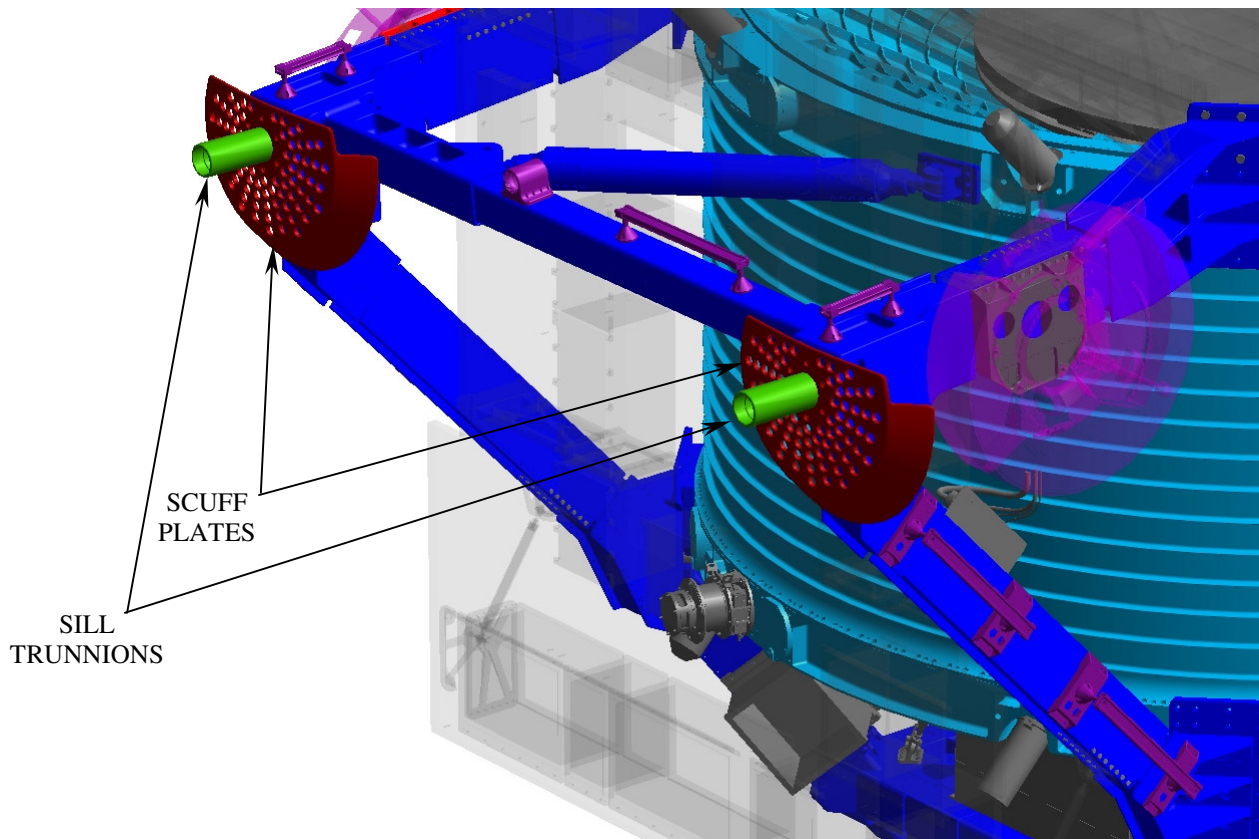


Figure 5.2-7 AMS-02 Shuttle Interfaces – Sill Trunnions and Scuff Plates

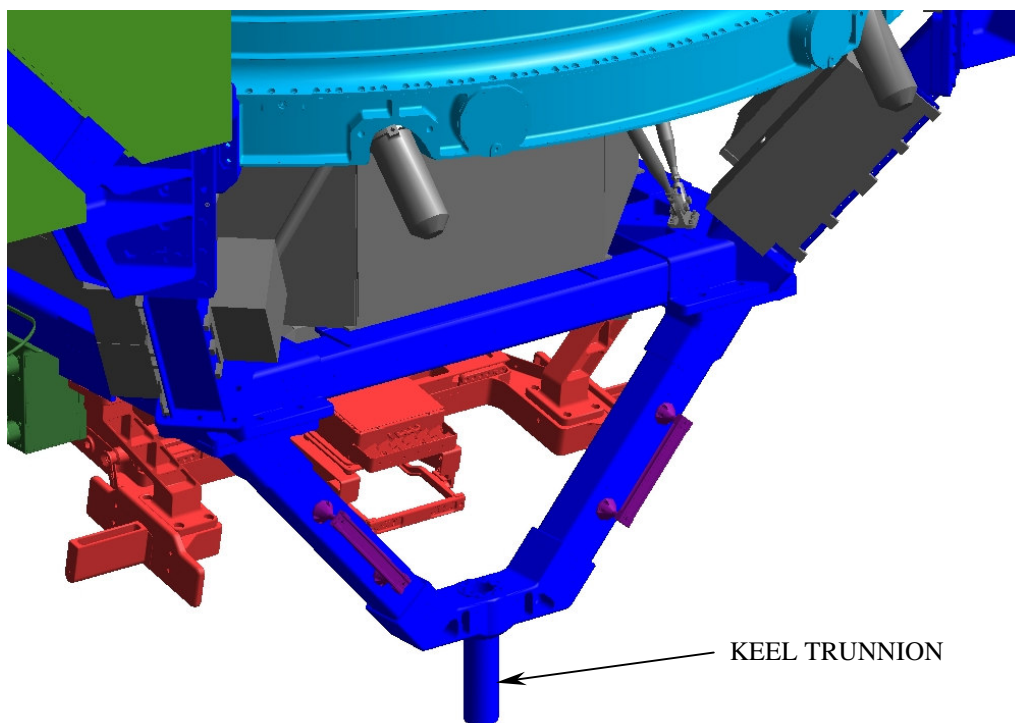


Figure 5.2-8 AMS-02 Shuttle Interfaces – Keel Trunnion

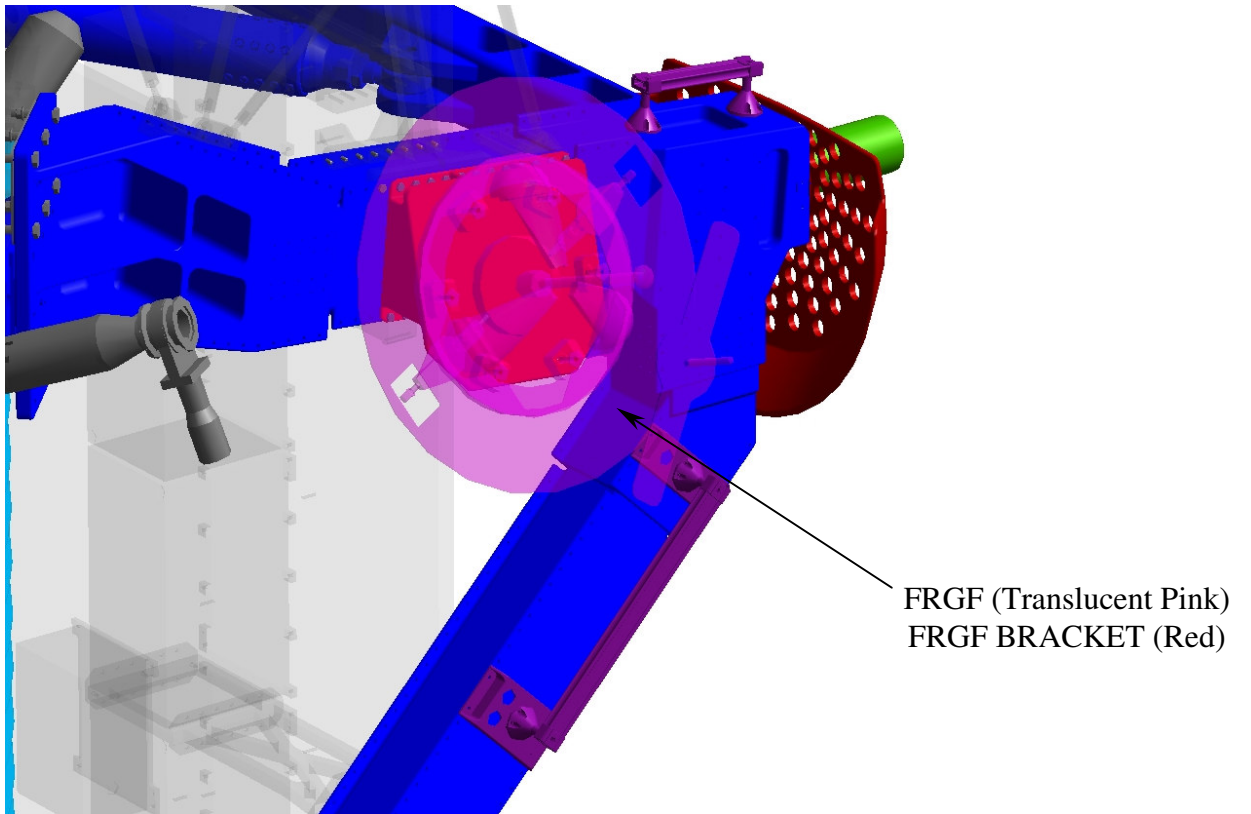


Figure 5.2-9 AMS-02 Shuttle Interfaces – FRGF

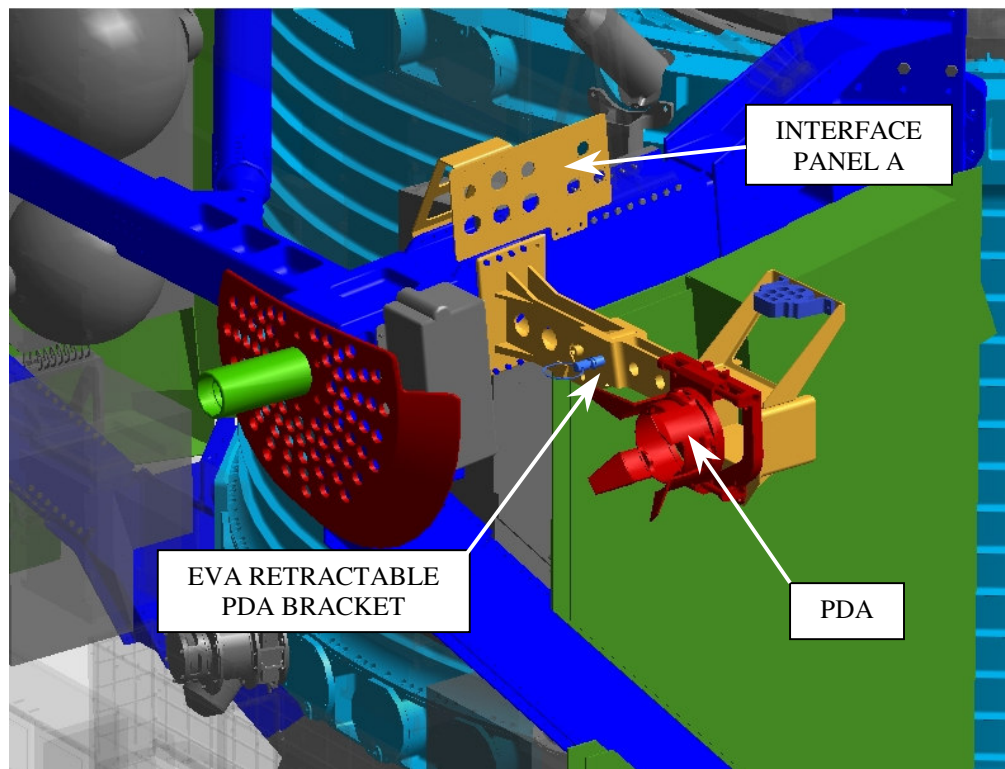


Figure 5.2-10 AMS-02 Shuttle Interfaces – PDA

The ISS interfaces include the AMS-02 Payload Attach System (PAS), UMA, and the Power Video Grapple Fixture (PVGF). The AMS-02 PAS interfaces with the ISS at the three Guide Pins, the Capture Bar, and the ISS provided Umbilical Mechanism Assembly (UMA) per the ISS Attached Payload ICD (SSP57003). The PAS has a mechanism to allow for an EVA crewmember to unload and release the capture bar so that the Payload can be removed from ISS in the event of a failure. Details of the AMS-02 PAS are covered in Section 5.3 of this SDP. The UMA is the power and data interface to ISS. It is GFE that is bolted to the Payload per SSP57003. The Power Video Grapple Fixture is the SSRMS interface used to berth the payload to ISS. It is bolted to the payload via a custom designed, machined 6061-T651 aluminum alloy bracket. The PVGF has the capability to provide power, video and data interfaces via the ISS SSRMS; however, the AMS-02 payload will only utilize the video (for EBCS operations) and power interfaces.

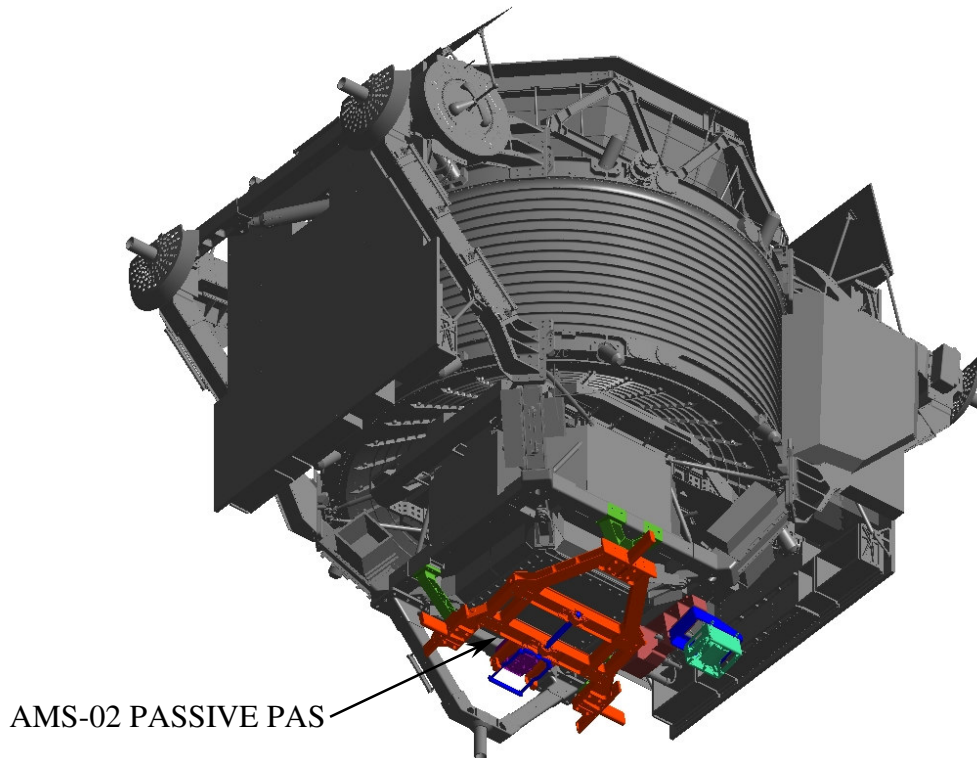


Figure 5.2-11 ISS Interfaces – Passive PAS

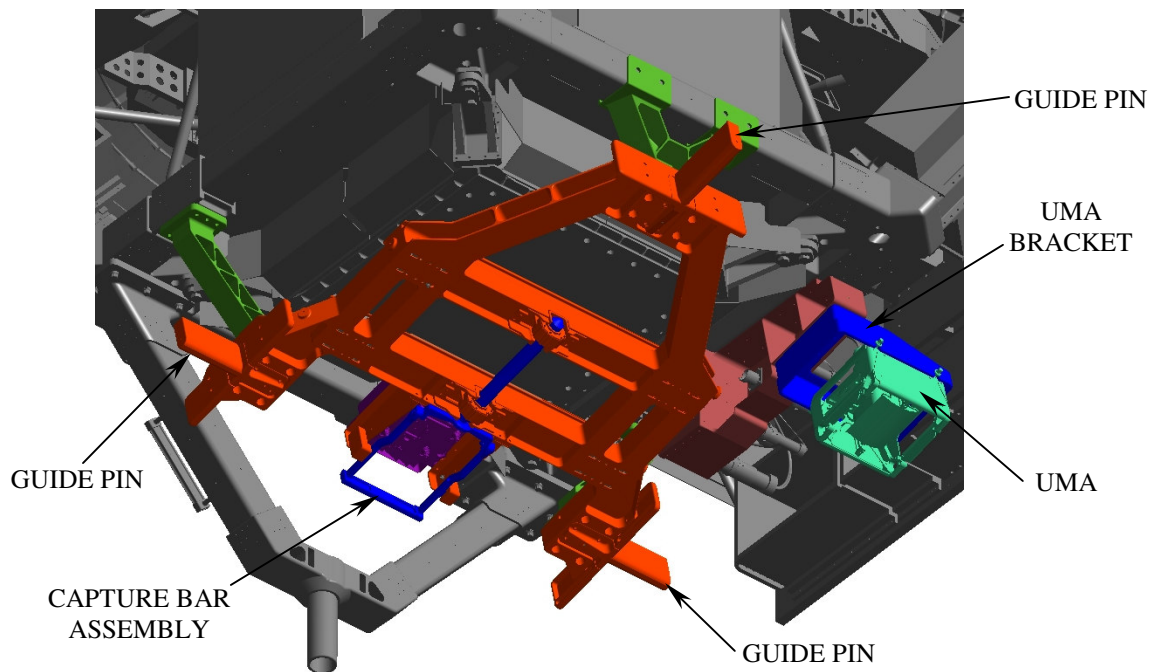


Figure 5.2-12 ISS Interfaces – Passive PAS

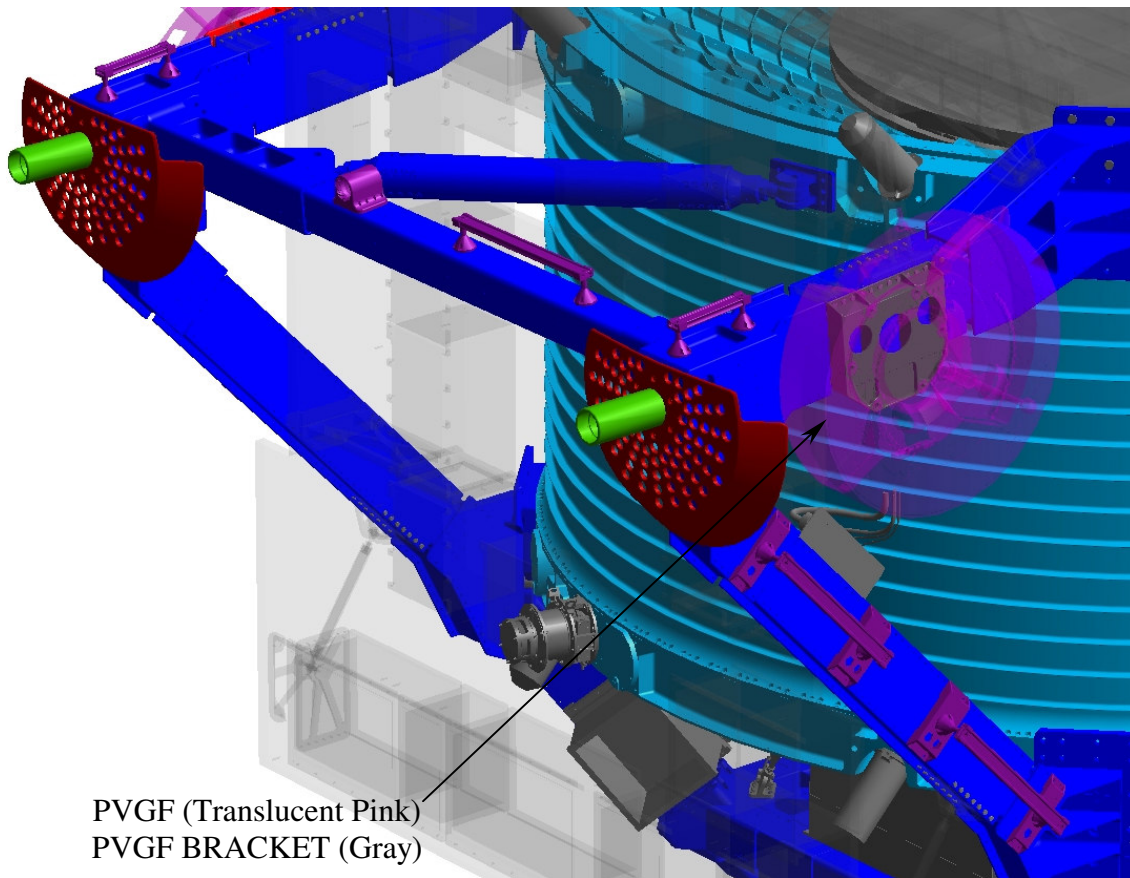


Figure 5.2-13 ISS Interfaces – PVGF

EVA interfaces include nine handrails, two WIFs, two sets of grapple release bolts on the PVGF and FRGF, two PAS unload bolts, one Capture Bar Release Handle, and the EVA Retractable PDA Bracket. All but three of the handrails are mounted to the USS-02 generic hole pattern via aluminum alloy 6061-T651 adapter brackets. The other three handrails are bolted to the aluminum alloy 7075-T73511 square tube extrusions. The WIF is mounted to an aluminum alloy 6061-T651 adapter bracket that is mounted to a square tube extrusion. The PAS unload bolts and the Capture Bar Release Handle are discussed in Section 5.3.2. The EVA Retractable PDA Bracket is discussed in Section 5.4.3.7.

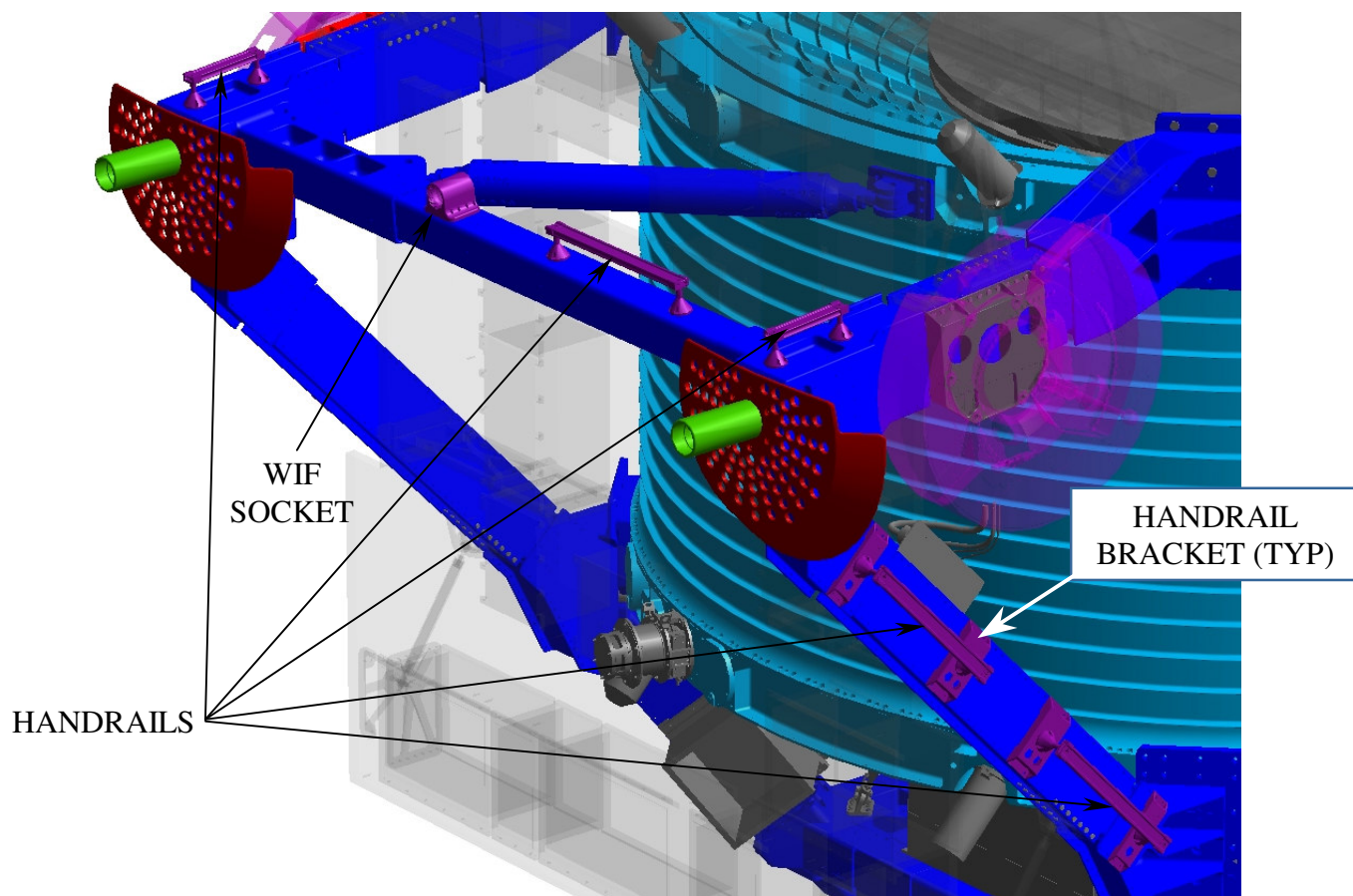


Figure 5.2-14 EVA Interfaces – WIF Socket and Handrails

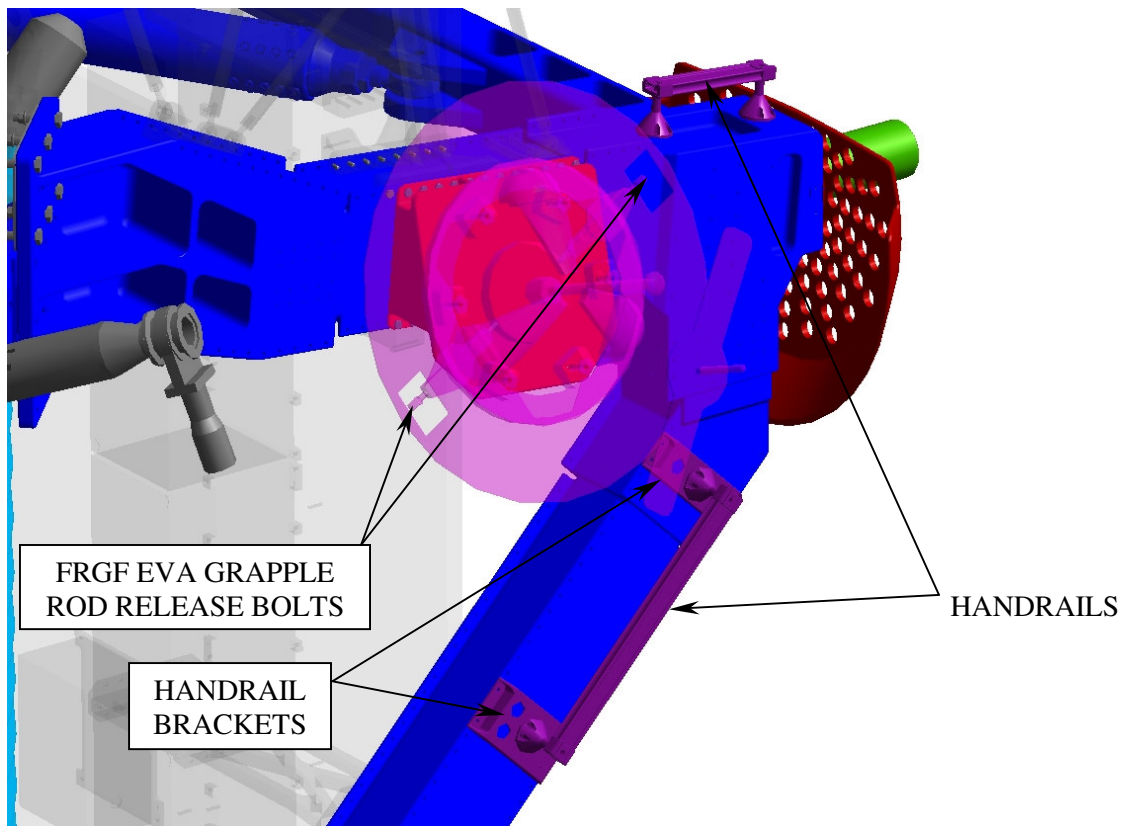


Figure 5.2-15 EVA Interfaces – Handrails and FRGF Release Bolts

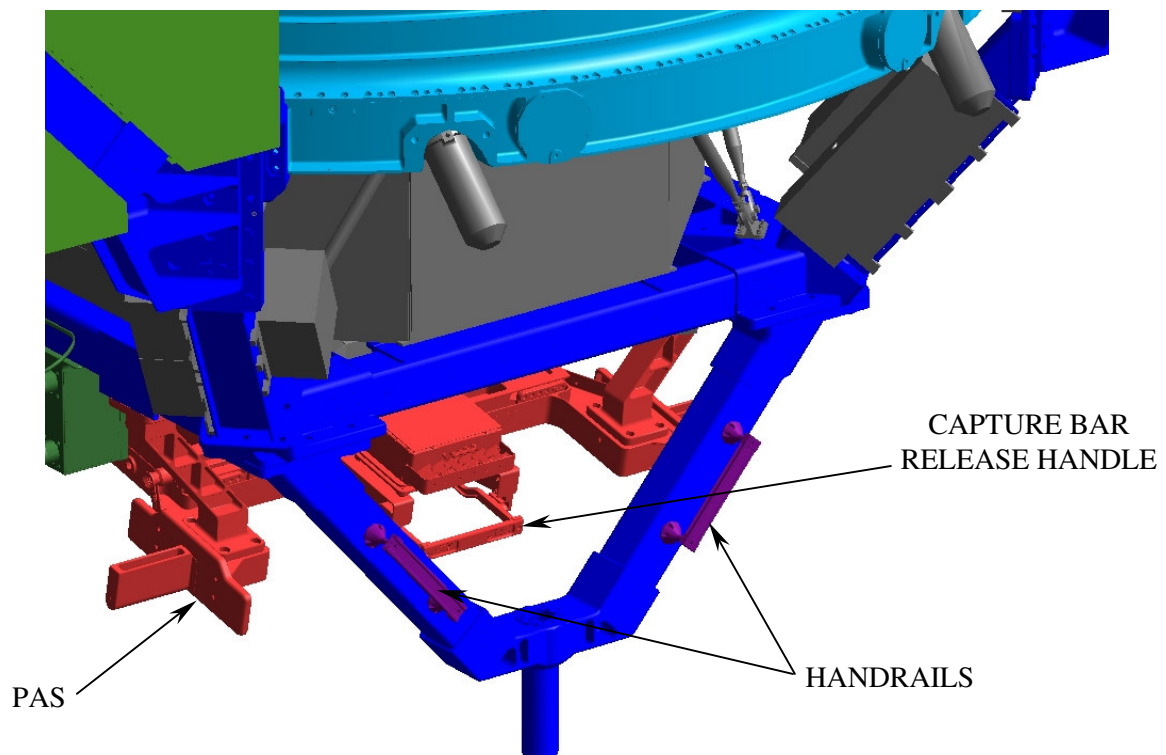


Figure 5.2-16 EVA Interfaces – Handrails and PAS Capture Bar Handle

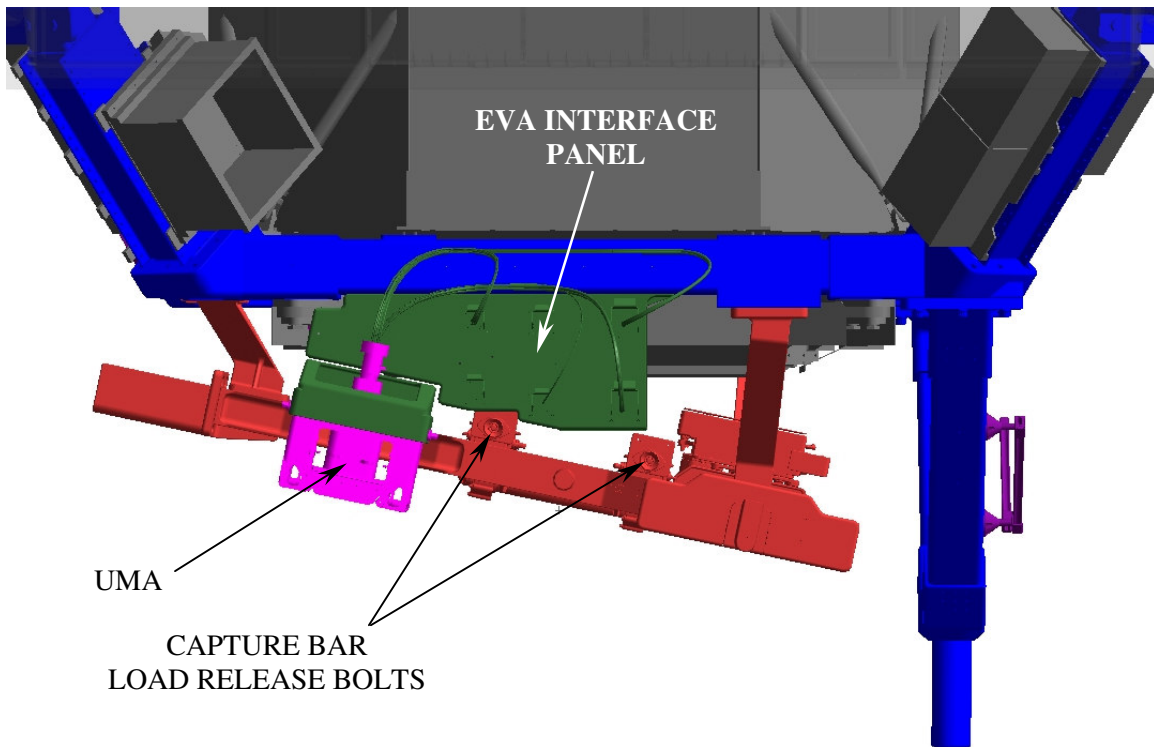


Figure 5.2-17 EVA Interfaces – PAS Capture Bar Handle

Two USS-02s will be built, the Flight USS-02 and the Structural Test Article (STA) USS-02. Each unit is structurally identical with the exception of the Lower USS-02. The Lower USS-02 is assembled in two configurations: Flight and STA. Both units have the same Keel interface but the Flight unit has additional interfaces used to secure the Payload for a special ground-shipping configuration.

The USS-02 will undergo structural testing. Structural testing will be performed per JSC 28792, AMS-02 Structural Verification Plan (SVP). This testing will include a full static test to 1.1 x limit load and a modal test.